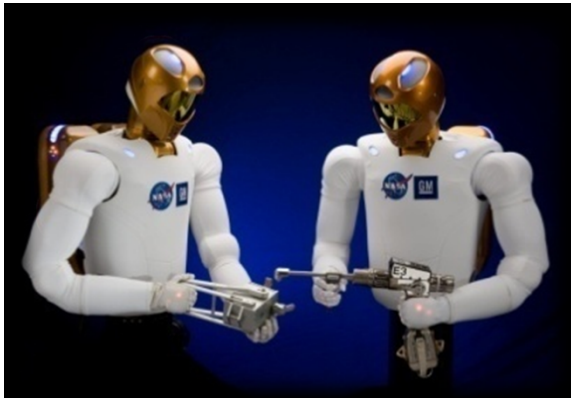
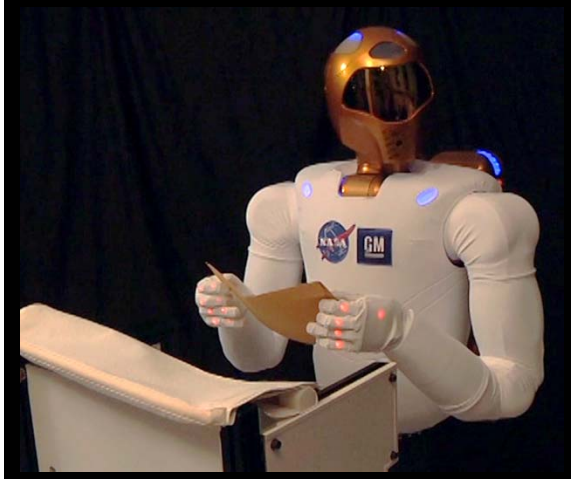
NASA/JSC Exoskeleton Technology

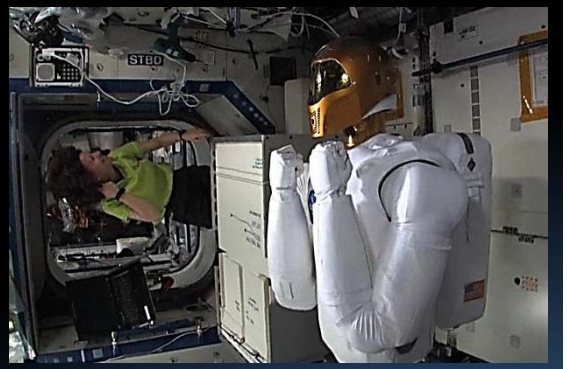
Robotic Systems Technology Branch

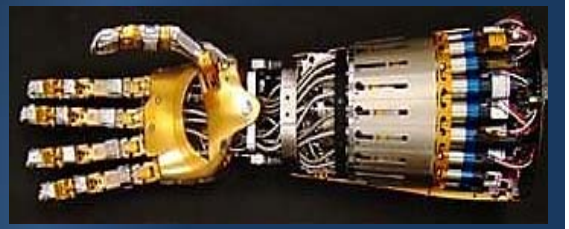
02/26/2014



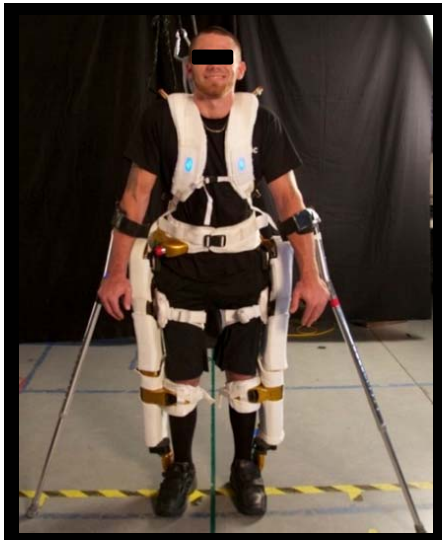


Robonaut2 is creating new possibilities for how we live and work in space





Through key partnerships exoskeleton technology derived from Robonaut2 is also improving how we live and work here on Earth



NASA Wearable Robotics - Bringing humans and robotics together in unique ways

X1- Exoskeleton

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- Co-developed with Institute for Human and Machine Cognition (IHMC)
  - Robonaut2 joint and control system technology spinoff
  - NASA applications
    - Exercise (rich data collection)
    - Dynamometry
    - Strength augmentation
  - Medical applications
    - Assistance for persons with paraplegia
    - Rehabilitation (rich data collection and fine control)
    - BMI (EMG/EEG)

X1

Adjustable comfort fit harness

Adjustable Backpack

Brainstem and Safety System (R2 derived firmware/software)

Adjustable thigh and shin interface to accommodate a large range of user

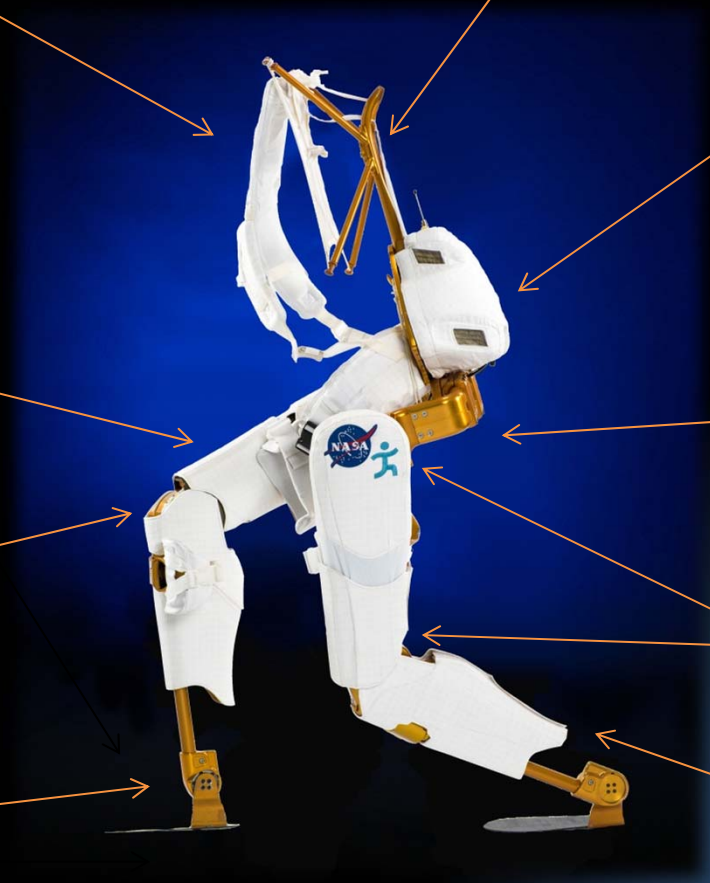
Passive hips for abduction & adduction and internal & external rotation

Integrated Hardstops

Powered Hips and Knees with real-time joint feedback

Passive ankle for plantar and dorsal flexion (powered ankle in design)

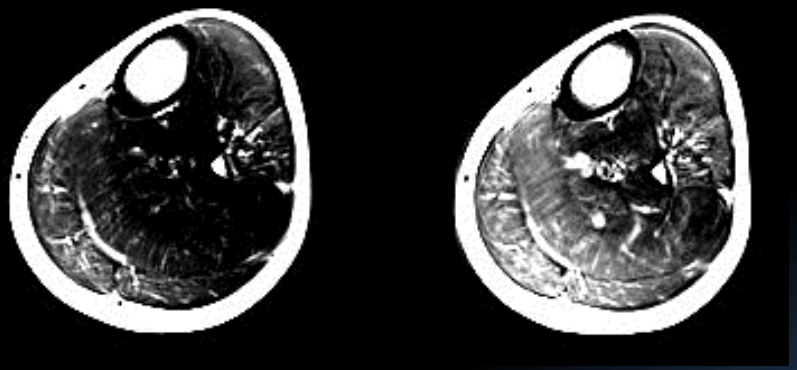
R2 Softgoods/Materials



Exercise/Dynamometry

- Powered ankle evaluated as an exercise device
  - MRI T2 analysis

MRI: right calf cross-section



Pre-exercise Post-exercise

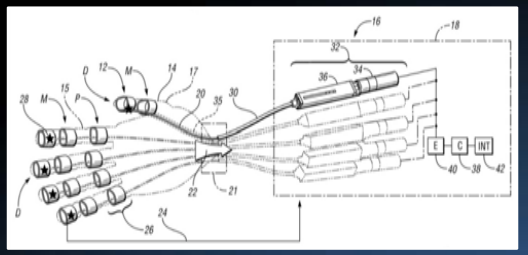
- Formal dynamometry studies have been performed with multiple test subjects
  - Knee and ankle

Medical Applications

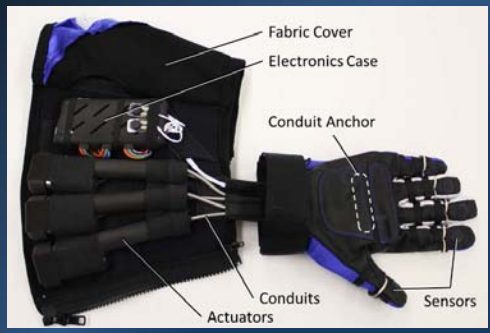
- Assisted Mobility
- Rehab/BMI

RoboGlove

- Co-developed with General Motors
  - Robonaut 2 hand technology spinoff
  - NASA applications
    - Reduce spacesuit glove resistance
  - Industrial applications
    - Reduce fatigue, ergonomic stress
    - Augment workers on reduced duty
  - Medical applications
    - Assistance for persons with spasticity due to stroke or weakness due to injury
      - Evaluated by subjects at Palo Alto VA



Grasp Assist Concept



Additional Activities

- Telemedicine with R2
- Exo expansion to include ankle
- Foot force/pressure sensing
- Warrior Web for upper body rehabilitation